Yoshio SHIMURA * : Study on the Spores of *Woodsia intermedia* TAGAWA and Esteemed Distinct Species of the Fern

志村義雄* イヌイワデンダの胞子の研究による独立種の推定

Introduction

At present, *Woodsia intermedia* TAGAWA grows only at two districts in Japan; Kayocho Okayama Prefecture[2,5,8] and Mt. Hachiman, Saga Prefecture.[8,12]

As regards the morphology of *Woodsia intermedia*, the previous reports were made by TAGAWA[2,3,5] and as regards the esteemed hybrid-origin of the species; another report was made by S. KURATA.[6] In order to reinvestigate the shape and surface of the spores which are dealt with in TAGAWA's paper and in order to conjecture whether a hybrid species or a distinct species from the morphology and development of the spores, I have carried out the observations and experiments.

I am grateful to Mr. S. BABA at Ureshinocho, Saga Prefecture, for his kindness in providing me with the material.

Materials and methods

As a control of the study, I used *Woodsia polystichoides* EATON and *Woodsia macrochlaena* METT. of which the morphology[1] and chromosome number[7,16] of the spores are already known. Because, TAGAWA[2,3,5] reports that *W. intermedia* has an intermediate characters between *W. polystichoides* and *W. macrochlaena*, moreover, KURATA[6] reports that the species seems to be hybrid-origin between the former and the latter.

The materials under my study was collected from the following districts. that is : *W. intermedia* was collected from Mt. Hachiman, Saga Prefecture by B. BABA in July, 1964 and a large number of sporangia of the material just maturated. *W. polystichoides* was collected from Nishido, Nakakawanecho, Shinden, Umegashimamura and Komatakyomaru, Harunocho, Shizuoka Prefecture.

W. macrochlaena was collected from Yawatano, Ito city, Shizuoka Prefecture.

These spores belonging three species were collected by the following method. Some laminas with the mature sporangia were placed on white sheet of paper of good quality. After 24 hours, I removed the laminas leaving spores on the paper. They were sorted using the faint breeze.

Germinating medium for these spores was MEYERS' solution containing 8% of Agar.

* 静岡大学教育学部生物学教室 Biological Institute, Faculty of Education, Shizuoka University.

In my experiments, four Petri dishes (9 cm in diameter) were prepared. The spores were sowed in the sterilized dishes which contains 20 c. c. of the medium, within a week after their collection. These dishes were placed on a table in the laboratory under the diffused light. The temperature in the laboratory was recorded by the thermograph.

The rate of germinated spores was decided as follows: After ten days or twenty days after the sowing, 500 spores per one dish were counted by the method of unintentional action through the microscope. Thus, average germinating rates of these spores were obtained out of the total germinating rates that are found from the four dishes. The photographs of these spores were taken by microphotograph.

Fig. 1 Spores of *Woodsia intermedia* ×600

Results

(1) The spores of *W. intermedia*

The mature time of the sporangia begin about in the latter part of June.

The fertile fronds form many mature sporangia and the collection of the spores is very easy. The spores are reniform-ellipsoid in shape, their surface is covered with thin perinium, which forms some evident large reticulate rugosity and its rugosity is ranges from 9μ to 12μ in height. their colour is brown. The spores are generally 68μ in long diameter and are also 45μ in short diameter (Fig. 1). The germinating rate of the spores is 91% (Table 1).

Table 1 Germinating rate of spores of *Woodsia intermedia*

Date of collection	Date of sowing	Date of count	Germinating rate (%)	Temperature (°C)	Locality
July 3, '64	July 9, '64	July 19, '64	91	24°～30°	Mt. Hachiman Saga Pref. Natural habitat

The spores germinated within several days after the sowing, their germinating energy is very good and they developed vigorously after their germination (Fig. 2).

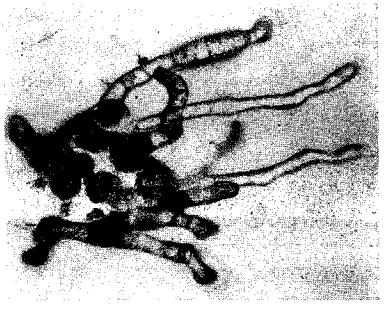

Fig. 2 Developmental stage of spores of *W. intermedia* in ten days after the sowing ×150

(2) The spores of *W. polystichoides*

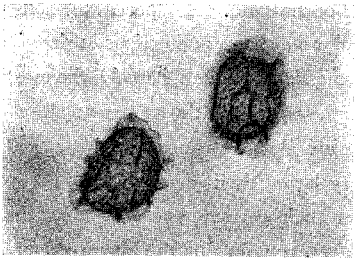

Fig. 3 Spores of *Woodsia polystichoides* ×600

OGATA[1] reports that the spores are reniform-ellipsoid in shape, their surface is covered with thin perinium, which forms some evident reticulate rugosity (Fig. 3).

In addition to these, the fertile fronds form many mature sporangia and the collection of the spores is very easy. The germinating rate of the spores is always more than 95% according to the same experimental method.

(3) The spores of *W. macrochlaena*

OGATA[1] reports that the spores are reniform-ellipsoid in shape, their surface is covered with thin perinium, which forms some faint rugosity (Fig. 4). In addition to these, the fertile fronds form many mature sporangia and the collection of the spores is very easy. The germinating rate of the spores is 88% according to the same experimental method.

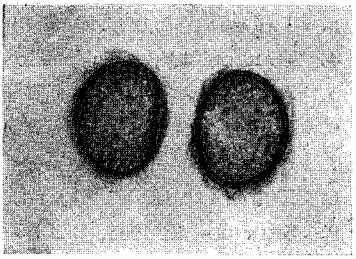

Fig. 4 Spores & of *Woodsia macrochlaena* ×600

Discussion

As TAGAWA'S report,[2] in my observation, the surface of spore of *W. intermedia* has also reticulate rugosity. However, it is a noticeable fact that the shape of spores of *W. intermedia* have some closer resemblance to the spores of *W. macrochlaena* than the spores of *W. polystichoides*. Because, TAGAWA [2,3,5] reportad that the fronds of *W. intermedia* have some intermediate characters between *W. polystichoides* and *W. macrochlaena*, having closer resembrance to *W. polystichoides*.

By the addition of the following some reasons to KURATA's report,[6] muchmore, the esteemed hybrid-origin of the species may be augment an aspect of certainty. That is : both the chromosome numbers of *W. polystichoides*[7] and *W. macrochlaena*[16] that seem to be the parents of *W. intermedia* have each the gametic chromosome of 41, the two species belong to the same Genus and they grow at very similar localities.

Howevr, as KURATA's report, even if *W. intermedia* may be derived from the hybrid of the two species, in the present time the theory of distinct species of *W. intermedia* is explained from my present study, my other past studies[9,11,13,14,15] and the other's report[4,10] on spore's morphology. That is : Both the spores

of some species[9,13,14] that seemto be a hybrid-origin and the spores of some hybrd-species[4,9,13,15] are generally always irregular in shape and various in size, in addition to these, the germinating rate of these spores is very small, namely, the most spores are sterile. Moreover, some hybrid-species[10,11] not form the spores at all.

On the contrary, the spores of *W. intermedia* are always regular in shape and are uniform in size, their germinating rate is very large, their germinating energy is very good and they developing vigorously after their germination. Namely, the most spores are fertile, in addition to these, a large n umber of the sporangia are mature and the propagation of the species seem to be acted only by means of spores. After all, the spores of *W. intermedia* are normal as well as both the spores of *W. polystichoides* and *W. macrochlaena* which is a distinct species as already known.

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摘　　要

田川[2,3]はイヌイワデンダの葉およびその他の形態的観点に基いて，それはイワデンダとコガネシダの中間的形態を具えた種類であると発表し，倉田[8]は同様な観点に基いて，このシダは前記両種間の種類であろうと報告している。

筆者は特にイヌイワデンダの胞子の形態，胞子嚢の成熟状態を観察し，胞子の発芽を実験し，この比較対照にイワデンダ，コガネシダの胞子を用いて実験，観察し，この諸結果に基いて，イヌイワデンダが独立種であるか，雑種であるか，その推論を試みた。

イヌイワデンダの胞子の形状は腎状楕円体で一定の型があり，その大きさは略揃ってい

る。すなわち整然たる一定の形，大きさを具える。胞子の表面には大きな網状の隆起物があり，これは田川の観察と一致した。その胞子の形態は同属であり，近縁のイワデンダの胞子よりは，コガネシダの胞子に近似する。この点は，田川がこのシダの葉部の形態はコガネシダよりはややイワデンダに近似することを指摘しているため，注目に価する。

イヌイワデンダの胞子の発芽率は高く（91%），その発芽勢は旺盛であり，発芽後の生長もまた良好であった。なお胞子嚢は稔性に富み，このため胞子の採集は容易であった。つまりこの胞子は正常である。

以上述べたその胞子の諸形質は，これにごく近縁であり，種として安定しているイワデンダやコガネシダの各胞子の形質に殆んど近似する。イヌイワデンダの胞子における諸形質から考察して，このシダはたとえ雑種起源であったとしても，現段階ではすでに独立種すなわち *Woodsia intermedia* TAGAWA であるとの結論に達した。